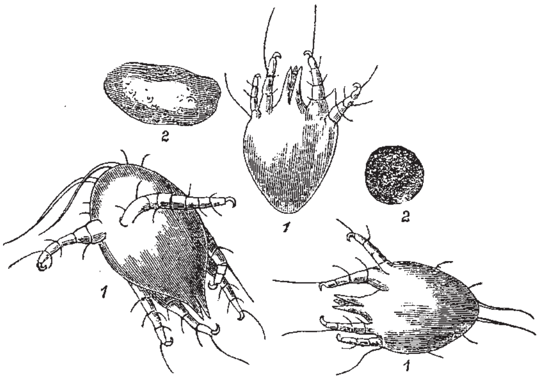
cane sugar, small pieces of the cane itself frequently occur in some descriptions of the latter. Of course it is impossible for them to be contained in loaf sugar, sugar-candy, or the finer kinds of sugar which undergo a careful process of purification.

A great deal has been said about the adulteration of sugar with sand, powdered marble, bone-dust, &c., and these tales are readily believed in by many people; but it is very unlikely that such insoluble substances would be used, as they would be sure to be detected. We know that inorganic substances are present in sugar, but we are inclined to believe that they are traceable to the imperfect cleaning of the cane or to the accidents, if we may so call them, attendant upon the process of manufacture.

Amongst the organic impurities often to be found in sugar, besides fragments of the cane before alluded to, are glucose or grape sugar, vegetable albumen, starch, minute fungi, and very frequently a number of small insects known as the sugar beetle (*Acarus sacchari*). The first of these, grape sugar, we have before described as being distinct from cane sugar, though its composition is nearly similar; as it is found most abundantly in grapes, whence its name; but it is also contained in various other fruits, as well in the dried state as in the fresh; and, moreover, it can be produced by the action of dilute sulphuric or other mineral acids, on starch or woody fibre, and so, in short, can be manufactured, which cane sugar cannot. It does not so readily crystallise as cane sugar, and the crystals are irregular, or have no definite form. It is much more clammy in an ordinary way, and dissolves or runs to juice at the least possible moisture of the atmosphere to which it is exposed. It is of less sweetening power than cane sugar, and is much more liable to ferment, therefore its presence with cane sugar tends to lessen the value of the latter.



MICROSCOPICAL APPEARANCE OF THE SUGAR INSECT (*Acarus sacchari*).—1. PERFECT INSECT.—2, OVA

The purest form of cane sugar to be obtained is that known as "lump," and for this reason it is always used in preserving fruit, as the chances of fermentation are thus diminished. Sugar-candy and all the large crystal or dry sugars are pretty sure to be free from glucose, because its presence would, according to the proportions, cause the sugar to be more or less clammy or moist. The presence of vegetable albumen and starch in cane-sugar is one step towards its conversion into grape sugar or glucose, and consequently increases its inclination to ferment. The removal of this vegetable albumen is one of the objects, as well as one of the difficulties, of perfect sugar refining.

The presence of minute fungi in sugar can only be detected by the aid of a microscope, but the sugar-beetle may be seen with an ordinary lens.

We know of no better way of detecting it along with other impurities than one which has been before recommended, namely, to place a teaspoonful or two of sugar in a glass of tepid water, let it stand till the sugar has completely dissolved, when the insects will be found, some perhaps at the top of the water and others at the bottom amongst the sediment. It is supposed that this insect is the cause of the irritation of the skin, more especially of the hands, from which grocers and those who have the handling of sugar are said to suffer.

Many other plants besides the sugar-cane and beet are used in their respective countries as sugar-producers. Thus, while we and our European neighbours receive our supplies from the two plants just alluded to, the chief sugar-producer in North America is a species of maple (*Acer saccharinum*), a large forest-tree; and in the East Indies several species of palms yield sugar.

With regard to the effects of sugar upon the system, it is abundantly proved that it is most valuable. Nature has so provided that it shall be diffused not only in the sap of young and growing plants, but also in milk, the food of the young of all Mammalia. Though sugar may be considered as a force producer, it is much more adapted to the young than to the adult, for it is not capable by itself of producing muscle.

JOHN R. JACKSON

NOTES

IN addition to the details given this week of the Eclipse Expedition by Mr. Lockyer and Mr. Langley, we have received from Prof. W. G. Adams a report of the Agosta section of the Expedition, publication of which we are compelled to defer till next week.

IT is with great pleasure we hear of the appointment of the Rev. F. W. Farrar to the Headmastership of Marlborough College. This institution has already set an example to our other public schools in the cultivation of Natural Science, which will, we trust, receive a fresh impulse under the new headmastership.

WE rejoice to hear that there is at last a chance of a large amount of scientific knowledge being required at the hands of naval and military officers. This is as it should be, and we earnestly hope that the long-needed reform will not stop here.

THE Austrian astronomers, MM. Weiss and Oppolzer, who went to Africa to observe the Eclipse, were, we regret to learn, as unfortunate as the other observers on that continent.

AT a meeting of the Master and Senior Fellows of Caius College, held December 14, 1870, the following College order was passed:—"That until as many as forty shares of the College income are applied to the promotion of the Natural Sciences and Experimental Physics, a sum equal to the deficit (estimated at 20*l*. a share) be taken from the balance for distribution, and paid to a fund called the 'Natural Science Fund.' That the shares applied to any Fellowship or Scholarship awarded for proficiency in the Natural Sciences and Experimental Physics be counted as so applied. That the Natural Science Fund be applied solely to the promotion of the study of Natural Sciences and Experimental Physics in any way whatever which, in the judgment of the College, may seem proper."

THE Birmingham and Midland Institute has done equal honour to Professor Huxley and to itself, by electing him to the office of President, in succession to the late Charles Dickens.

DR. WOOD has been appointed Lecturer on Chemistry at the St. Mary's Hospital Medical School, in succession to Dr. Russell, transferred to St. Bartholomew's.

WE understand that Dr. Michael Foster and Mr. Watts are engaged in translating Kühne's "Physiological Chemistry."

WE hope in succeeding numbers to give in full Dr. Carpenter's and Mr. Gwyn Jeffreys's Report on Deep-sea Researches carried on during the months of July, August, and September 1870, in the *Porcupine*, recently read before the Royal Society.

WE quote the following pleasant "international" from the *New York Technologist*:—In view of recent remarks concerning the action of the British Government in regard to the expedition proposed by British scientific men, for the purpose of observing the approaching eclipse, it is but justice to say that on proper representation being made to Mr. Lowe, the Chancellor of the Exchequer at once expressed his opinion that such an expedition was one eminently worthy of government aid, and perfect arrangements as regards ships, funds, &c., have been made. One good result has, however, attended this delay on the part of the British Government—it has afforded an opportunity for the exchange of very pleasant courtesies between the scientific men of the United States and those of Great Britain. As soon as Prof. Peirce heard that their government had refused the use of the necessary ships, he at once tendered to the English scientists all the facilities at his command; and they were ample. No one doubts that, under similar but opposite circumstances, the same offer would have come from the other side; for, however stubbornly *Alabama* controversies may hold out, science takes no cognizance of them."

WE are informed that the series of penny lectures on Natural Science, delivered at the Hulme Town Hall, are to be obtained in London of Mr. Pitman, Paternoster Row.

A DEPUTATION from University College, London, consisting of Mr. George Grote, the president, the Hon. George Denman, M.P., Mr. Julian Goldsmid, M.P., and Dr. Storrar, members of the Council; Prof. Fuller, C.E., Prof. Williamson, F.R.S., and Mr. J. Robson, the secretary, has waited upon the Duke of Argyll, at the India Office, to present a memorial from the Council and the Senate of the College, on the subject of the proposed institution of a new Engineering College for the Indian Service. The interview with his Grace lasted upwards of an hour. The memorialists consider that the deficiency in the present system has arisen, not from any defect in the existing places of education, but from the injudicious system of examinations hitherto pursued, and from a want of sufficient inducements to well-qualified men to enter on the career proposed to them. The memorialists assume that the latter cause is recognised by the Government, for it is understood that it is in contemplation to augment considerably the salary upon which a civil engineer in the service of the Indian Government will hereafter commence his work. The memorialists believe the proposed college will be prejudicial to the public service by narrowing the field for the selection of candidates, and by limiting their means of obtaining the requisite instruction. They submit that the working of Government colleges has not been such as to recommend the creation of a new Government college, having practically the monopoly of appointments, and protected from competition. They suggest that such a step is at variance with the plan for throwing open to all Her Majesty's subjects the opportunity of gaining Government appointments.

AT a meeting of the Royal Geographical Society, held on the 9th inst., Dr. Carpenter read a paper on Oceanic Circulation, especially in reference to the inset current into the Mediterranean through the Straits of Gibraltar. After detailing the theories which have hitherto been propounded to account for this current, all of which he pronounced to be unsatisfactory, Dr. Carpenter propounded the following explanation:—The water of the Mediterranean has a uniform but limited excess of weight over that of the Atlantic—so limited as to do away altogether with the idea that there is an accumulation of salt in the Mediterranean. The excess of salt was found to be greater in the lower than in the upper stratum of water, and thus the excess of evaporation was produced. If there be two columns of water of equal density—one that of the Atlantic, the other that of the Mediterranean—an excess of evaporation lowers the height of the Mediterranean column. If the Atlantic column were of fresh water, just enough would flow in from it to restore the evaporated water. But it is salt water which actually flows in from the Atlantic, and therefore it produces an increase of pressure, which presses the Mediterranean water outward till the equilibrium is restored. This being restored, there is once more a reduction of the Mediterranean level by evaporation, and so on; and, therefore, a circulation is always going on between the waters of the Mediterranean and Atlantic. The only difficulty in receiving this explanation is that the water of the outward-flowing current must run uphill; but other examples, he stated, are known. The fact that such a circulation exists, he said, is now indisputable, recent experiments having satisfactorily determined the evidence of a westerly current underlying the surface easterly current. These currents are, therefore, only a portion of the general oceanic circulation, which causes a perpetual surface motion of warm water from the equator to the pole, and a counter under-current of cold water from the pole to the equator. In replying to objections raised in the course of the discussion, Dr. Carpenter said that he had only broken ground in the enunciation of his theory, which it would require much labour yet to work out. Sir Henry Rawlinson, who occupied the chair, stated that in consequence of the continued illness of Sir R. Murchison, he had been appointed president of the Society *ad interim*.

THE Wind-Chart, to which we referred last week, furnished daily by the Meteorological Office to the *Shipping and Mercantile Gazette*, is the invention of Captain Charles Chapman.

FROM the annual report, it appears that the gardens of the Dublin Zoological Society have been very successful, the number of visitors being 136,000, and a considerable balance lies in favour of the society. The donations of axolotls from Prof. Wyville Thomson, and of Mammoth Cave fishes from Prof. Mapother, are acknowledged, but it is not stated if they live or have undergone any developmental changes.

THE following regulations have been issued by the Science and Art Department with regard to science teachers who wish to attend the special (six weeks') courses for training in teaching at South Kensington in June, July, and August, in accordance with the circular of September 1870. These applications are so numerous that it is impossible for the Department to make the selection of teachers to attend, as was originally proposed. The Department has therefore decided to make the selection by competition at the next May examinations. The competition for those who wish to attend the instruction in Biology will be in Animal Physiology, Zoology, Vegetable Anatomy and Physiology, and Systematic and Economic Botany. The candidate may take up all the four subjects, but a fair proficiency in Animal Physiology and in Vegetable Anatomy and Physiology will be essential. If this proficiency is shown, the marks obtained in the other subjects will be counted. By fair proficiency is understood the amount of knowledge required to pass in the advanced stage. For those who wish to attend in Experimental Physics, the competition will be in Acoustics, Light and Heat, and in Magnetism and Electricity. A candidate will be required to take up the honours' papers in those subjects in which he teaches, or in which he is qualified to earn payment, but in any of the other subjects of the group in which he is competing he may take the advanced or the elementary paper. The marks obtained in these subjects will count as in the competition for Royal Exhibitions. The papers of the teachers who are competing will be specially and separately looked over by the professional examiners—the examination being competitive only—and the teachers who answer best, probably to the number of about forty-five in each group, will be allowed to come to London for the six weeks' course of training. They will receive their travelling expenses, namely, second-class railway fare, and 30*s.* a week while in London. The results of the teachers' examination will not be published. Each candidate will be informed of the position in which he would have been placed had he been examined as an ordinary candidate for honours. If he wish his success recorded, it will be done in the ordinary way. The Biology course will commence on the 14th June, and the course on Experimental Physics on the 5th July. It must be understood that no teachers, except such as come up under the foregoing rules, will have travelling allowances under § lxviii. of the Science Directory. No persons are eligible to receive the allowances granted in this minute except those who have been engaged in science teaching under the Science and Art Department during the session 1870-71.

IT appears from Mr. Glaisher's Meteorological Tables, that while December 25 was the severest day of the recent frost in the neighbourhood of London, it was still more intense in other localities on January 1, falling as low as 4·9° at Wolverhampton, 5·0° at Hull, 6·7° at Bradford, 7·0° at Leeds, and 9·7° at Leicester, the minimum at Blackheath on that day being as high as 19·2°, although at Twickenham, as reported by Mr. Hall last week, the thermometer fell as low as 6·3°. As on Christmas Day the severest cold was again in the Midland and North Midland counties, and we have once more to record the phenomenon to which we have had occasion to allude more than once recently, that the frost was considerably more intense in England than in Scotland. For the week ending January 7, no lower temperature was recorded at any of the Scotch stations than 21·0°, at Dundee; the mean temperature for all the English stations was 29·6°, while for all the Scotch stations it was 35·5°, or more than 6° higher. From the 20th of December to the 13th of January, when the frost finally broke up, the temperature in London was only even slightly above the mean of the last fifty years on three days.

THE Rev. Mr. Gribble, F.R.S., reports from Constantinople that after a fine morning the disc of the sun in the late eclipse was obscured for some time, so that it was not well seen until $3^h\ 26^m$ mean time, when there was only about one-eighth of the disc clear. A large solar spot then became uncovered; clouds coming on again, this was all that was seen clearly. At $3^h\ 26^m$ the light was considerable.

THE *Scottish Naturalist*, to which we referred some weeks since as a new periodical proposed to be issued under the auspices of the Perthshire Society of Natural Science, has made a good beginning. Opening with a short programme of future operations, in which the editor, Dr. Buchanan White, wisely states his intention of restricting the contributions to papers and notes especially bearing on Scottish Natural History; we then have an article by Dr. Lauder Lindsay "On Natural Science Chairs in our Universities," to which we may possibly take occasion again to refer. The writer deals with a bold hand with the evils which are said to prevail more especially in the election of Professors in our northern Universities. He refers to the manner in which these appointments are stated often to be regulated by political influence or religious belief rather than by possession of qualifications to teach Natural Science, and is especially severe on the system of personal canvass and the "testimonial nuisance." Mr. J. A. Harker contributes a paper "On the Work and Influence of Local Natural History Societies;" Mr. George Norman a List of the Noctuæ occurring in Morayshire; the editor some hints on Sugaring, how, when, and where to do it; and an anonymous contributor, a paper "On the Mollusca of the North-east of Scotland," illustrated with a map. Some shorter articles and notes with reports of proceedings of Scottish Natural History Societies, make up the number, which we commend to the notice of all interested in natural history across the Border.

HENDERSON'S PATENT PROCESS FOR REFINING CAST-IRON

AN article was furnished a short time ago, and published in NATURE (No. 57, p. 94), respecting a new process for the production of steel by the partial decarburisation of cast-iron, invented by the writer. It was then stated that a description of a new process for refining cast-iron would soon follow.

This process supplies a more effective and economical process than the English finery or the German reverberatory furnace processes for refining cast-iron. It is very simple, and does not require any fuel, labour, or expensive apparatus; and there is no loss of weight of iron, as the impurities go off in vapour. The cost of refining is less than one-twentieth of that of the English and German processes; and its effect is more thorough than is possible by those systems.

The agents used are fluorine and oxygen combined. The fluorine is derived from any fluoride, and the oxygen from any substance containing or capable of evolving oxygen, which is adapted to use in the manufacture of wrought-iron and steel. Fluorspar and pure rich iron ores are the most available and economical substances for producing these agents, and are applied finely powdered and mixed, and placed in receptacles, preferably, so as to act from the under side upwards upon cast-iron in its molten state.

The most economical mode of application of this process is to treat the cast-iron in the condition in which it flows from the blast furnaces, with fluorspar and iron ore, applied in the "chills" or pig moulds used at blast furnaces, by being spread over the bottom of the moulds.

The iron, when tapped from the blast furnace, flows into the mould thus prepared; the heat of the iron causes fluorine and oxygen to be liberated, and, by reason of the affinities of these substances for silicon and phosphorus, these impurities are removed in the form of *vapour*. The reactions in the "chills" are similar to those of the boiling puddling process, and last about five minutes. The metal during this period is covered with jets of flame and smoke. The resulting metal, with respect to silicon and phosphorus, is as pure as wrought-iron.

It is preferable to use iron ores containing the largest amount of oxygen and the least of silica and phosphorus. These conditions exist in "washed iron sands," and the red hematites of Cumberland and Lancashire. When using the hematite ores, varieties that are the easiest to reduce to powder are preferred; and the ordinary edge running apparatus, with cast-iron rollers revolving in a pan, is an excellent one for the purpose.

The fluorspar and fine ore are passed through a sieve of not less than four hundred meshes to the square inch, and afterwards mixed so thoroughly as to appear to be one substance, in the proportion of one part of fluorspar to two parts by weight of iron ore, and are spread one-fourth to three-eighths of an inch deep over the "chills," then the iron is run upon them so as to form slabs one inch thick.

The former article gave analyses of refined cast-iron produced in the reverberatory furnace. It will be seen by comparing the analysis of the refined metal of this process with the analysis of that of the reverberatory furnace process, that they are analogous, except that the latter contains no silicates or graphite. The refined metal of the pig-mould process saves the fuel and time taken for refining by the reverberatory furnace process, and shortens the time of producing steel or wrought-iron by that process fully forty minutes. When using the refined metal of this process two workmen can take charge of five ordinary boiling puddling furnaces making steel, and six furnaces making wrought-iron, as the only labour necessary is "balling" and removing it from the furnace. When high carburised steel is made, "balling" is not required, as